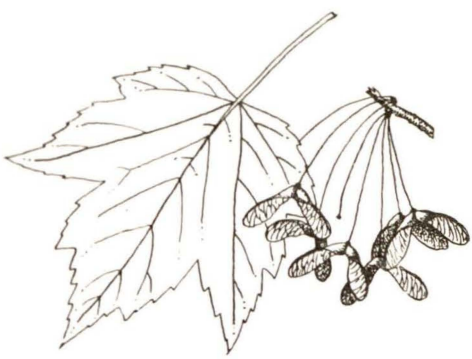
Silvical Characteristics of Red Maple

(*Acer rubrum*)

by Russell J. Hutnik
and Harry W. Yawney



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RALPH W. MARQUIS, DIRECTOR

Preface

MUCH of the silvical information on our forest trees is widely scattered and sometimes difficult to find. To make this material more readily available, the Forest Service is assembling information on the silvical characteristics of all the important native forest tree species of the United States. It is expected that this information will be published as a comprehensive silvics manual.

This report presents the silvical characteristics of one species. It contains the essential information that will appear in the general manual but has been written with particular reference to the species in the Northeast. Similar reports on other species are being prepared by this Experiment Station, and by several of the other regional forest experiment stations.

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The Red Maple

RED MAPLE *(Acer rubrum* L.) is also known as Carolina red maple, scarlet maple, soft maple, swamp maple, water maple, and white maple. Taxonomists recognize several varieties of red maple. The most common is Drummond red maple *(Acer rubrum* var. *drummondii* (Hook, & Arn.) Sarg.) *(29)*.

Throughout much of its range, red maple is considered an inferior and undesirable tree. It is susceptible to physical injury and is often attacked by fungi. Heart-rot is prevalent; most mature trees are hollow-butted. Red maple often has poor form, especially on poor sites.

In some areas, however, it compares favorably in form and quality with sugar maple. Red maple of good form and quality is a highly desirable tree and logs from such trees are often considered equal in value to those of sugar maple and the better oaks.

Red maple is found throughout the eastern United States from the Atlantic Ocean to the prairies and from southern Florida to Canada (fig. 1). In Canada, red maple occurs as a scattered tree in the Maritime Provinces and in southern Quebec and Ontario. It reaches its best development in the mountains of Kentucky, Tennessee, and nearby states *(5)*. The variety Drummond red maple is found in the lowlands of the Atlantic Coastal Plain and the lower Mississippi and Ohio valleys.

Habitat Conditions

CLIMATE

Red maple grows under a wide variety of climatic conditions. Its range in North America is restricted in the North by the extremely cold climate in Canada and in the West by the dry climate of the Prairie States.

In the United States, red maple grows almost everywhere east of the 100th meridian where precipitation is adequate to support tree growth. Of all the maples, it has the widest tolerance to climatic conditions (fig. 1).

SOILS AND PHYSIOGRAPHY

The range of red maple covers a number of soil formations, such as podzols, brown podzolic soils, gray-brown podzolic soils, red and yellow podzolic soils, bog soils, alluvium soils, and lithosols and shallow soils *(44)*. It occurs on both glaciated and non-glaciated soils derived from granites, gneisses, schists, sandstones, shales, slates, conglomerates, quartzites, and limestone.

It occurs over a wide range of soil textures and soil-moisture conditions. In fact, red maple is more common under the more extreme soil-moisture conditions--either very wet or quite dry. However, it makes its best development on moderately moist sandy loam soils.

Red maple grows over a wide range of topography and elevations. Although reaching its best development on moderately well drained moist sites at low to intermediate elevations, it is common in mountain country on the drier ridges and on south and west exposures of upper slopes. On the other hand, it is also common in swampy areas, on slow-draining flats and depressions, and along small sluggish streams. In the South, it is a bottomland species. In the extreme northern part of its range, it is limited to river valleys and alluvial flats.

BIOTIC

Red maple probably is the most widely distributed tree species in the East. It is a component of 56 of the 106 cover types listed for North America *(39)*, and is a major component in three of these: the gray birch-red maple type in the Northern Forest Region; the black ash-American elm-red maple type in the Northern Forest Region and intruding into the Boreal Forest Region; and the sweetbay-swamp tupelo-red maple type throughout the lower coastal plain. Although red maple usually occurs in mixed stands, it does form pure stands in many of the swamps in the Northeast.

Considering its range as a whole, red maple is associated with more than 70 different commercial tree species. In the North, some of the more common associates are: gray birch, yellow birch, paper birch, black ash, American elm, white pine, sugar maple, beech, black cherry, northern red oak, basswood, and red spruce. In the South, it is associated with black gum, slash pine, loblolly pine, American elm, green ash, pin oak, and southern red oak. It is found on dry sites in mixture with chestnut oak, black oak, bur oak, and scarlet oak; and on wet sites with tamarack, balsam

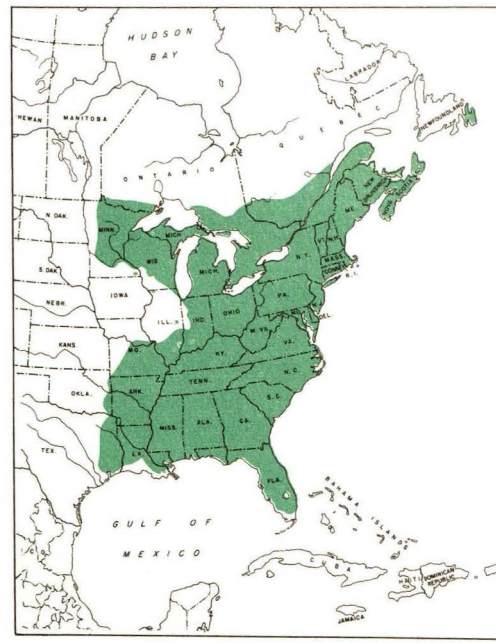

Figure 1.--*The natural range of red maple.*

DISTRIBUTION MAP BY
ELBERT L. LITTLE, JR.
U.S. FOREST SERVICE

fir, swamp tupelo, sweet bay, bald cypress, black willow, and water tupelo.

Red maple is usually considered a pioneer or subclimax species. In the Northeast it often occurs with other pioneer species such as pin cherry, aspen, paper birch, and white pine. However, it is longer-lived and more shade-tolerant than such species as pin cherry and aspen, and functions as an intermediate in many forest stands. On the better of the sites occupied by Virginia pine in Pennsylvania, red maple is the most common understory hardwood. It may be considered as forming a physiographic climax on some wet sites in the Northeast.

The forests in which red maple occurs serve as cover for many mammals and birds. In addition, red maple is important as a preferred browse food of the white-tailed deer, especially during the winter *(7, 24)*. Moose also browse on the foliage and twigs. Many of the smaller animals such as rabbits, beavers, squirrels, chipmunks, and porcupines feed on the seeds, flowers, bark, and twigs. Many birds such as grouse, finches, grosbeaks and nuthatches feed on the seeds, buds, and flowers *(30)*.

Life History

SEEDING HABITS

Red maple is one of the first trees to flower in the spring (fig. 2). The dates vary from February at lower elevations in the South to May at higher elevations northward *(45)*. The flowers are structurally perfect but never functionally perfect *(48)*. The species tends to be dioecious but is not completely so--a condition designated in taxonomic manuals as polygamodioecious. Thus some trees are entirely male, producing no seeds; some are entirely female; and some bear both male and female flowers, that is, are monoecious. On monoecious trees male and female flowers tend to be localized on different branches.

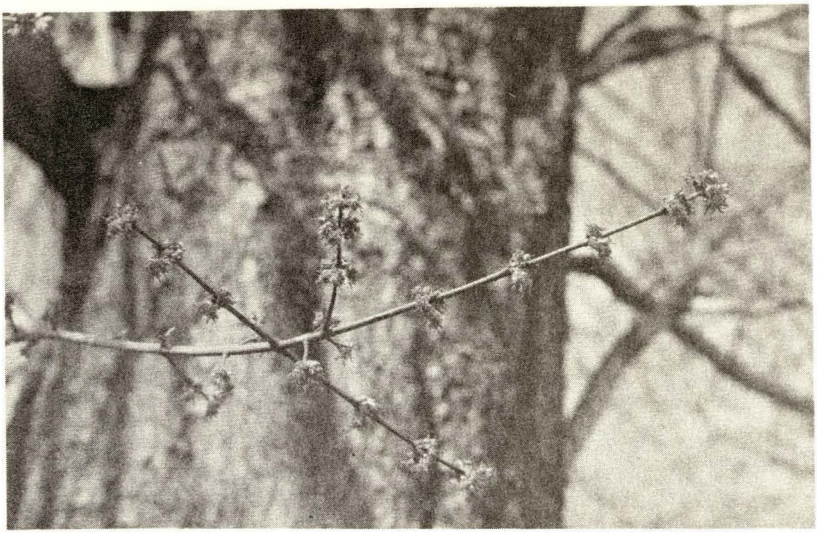

Figure 2.--*The flowers of red maple. These bright red flowers bring color to the forest in the spring, for the red maple is one of the first trees to burst into bloom.*

A good seed crop occurs almost every year *(45)*. The fruit, a samara, ripens from March to late June, depending upon location. The dispersal period is about 1 to 2 weeks, occurring sometime between April and July. The seed is rather efficiently disseminated by the wind: the wind causes the seed to spin, and this slows its rate of descent and allows for greater drift. The seed is the lightest of all the maples, averaging about 23,000 to the pound. Germinative capacity is fair; it averages 46 percent *(45)*, although some tests have shown from 90 to 100 percent germination.[1]

VEGETATIVE REPRODUCTION

Red maple is a vigorous sprouter (fig. 3). In the northern hardwood forests it is second only to basswood in this respect *(14)*. Many of the second-growth stands in the Appalachian Mountains include a large proportion of red maple sprouts. The multiple sprouts grow rapidly at first

[1]Minckler, Leon S., and Hosner, John. Personal correspondence. 1956.

but soon lose early vigor as competition increases. Many of them develop butt rot at the base.

Red maple reproduction resulting from layering has been observed in Central Pennsylvania. [2]

Red maple is considered difficult to propagate from cuttings *(1)*. However, fairly good results have been obtained by treating the cuttings with a concentration of 200 mg./l. of indolebutyric acid for 3 hours *(38)*. Even with chemical treatment, the success of rooting red maple cuttings varies considerably. Cuttings taken in June seem to root better than those taken later *(38)*; cuttings from the lower part of the crown root better than those from the upper part; and cuttings from male clones or from female clones that are fruiting sparingly root better than those from female clones that are fruiting heavily *(13)*.

Successful bud-grafting on an experimental basis has been reported with red maple, and with sugar maple on red maple stocks *(35)*.

SEEDLING DEVELOPMENT

Most red maple seeds germinate soon after falling, in early summer. A few lie over until the following spring. The seeds do not need much light to germinate *(31)*. Red maple is probably among the least exacting of all forest trees in its requirements for germination: all it needs is proper temperature and only a little moisture.

Moist mineral soil seems to be the best seedbed. A thin layer of hardwood leaf litter seems to be no impediment if the underlying soil is moist and mellow. On such seedbeds, whether they be abandoned fields, cutover areas, burns, or in the forest, large numbers of red maple seeds germinate nearly every year. Although relatively few survive until the next growing season, enough seedlings become established to perpetuate the species in abundance.

Red maple also can germinate and become established on less favorable seedbeds. For instance, in Pennsylvania,

[2] Chisman, Henry H. Personal observation in central Pennsylvania.

Figure 3.--*A typical sprout clump of red maples. This species is a vigorous sprouter.*

West Virginia and Ohio, it is one of the species that come in on spoil banks after strip-mining *(8, 36)*. On these sites, however, first-year survivals may be very low, and seedlings that do survive generally grow poorly. Red maple planted on spoil banks in Indiana was distinctly inferior to green ash, sycamore and several other hardwoods in survival, growth rate, and growth form *(11)*.

The adaptability of red maple to widely varying site conditions is demonstrated and, in part, explained by the responsiveness of the root systems to differences in soil environment. Seedling red maples on wet sites form short taproots with long, well-developed laterals; on dry upland sites they produce deeply penetrating taproots and much shorter laterals *(42, 43)*. On such dry sites the taproot may reach a depth of 10 to 13 inches the first year.

The ability of this species to grow on poorly drained or wet sites is shown also by the behavior of seedlings in soil-saturation experiments: when subjected to saturated soil conditions shortly after germination for periods up to 32 days, red maple seedlings, although somewhat stunted, all survived and upon removal from saturation recovered very rapidly *(32)*.

With favorable light and moisture conditions, red maple seedlings make fast, vigorous growth--as much as 1 foot the first year, and up to 2 feet or more annually during the next few years. Stump sprouts grow even faster at first--3 feet or more the first year. However, their growth rate soon subsides to about the same as for seedlings. Because of the aggressiveness and rapid growth of both the seedling and sprout reproduction of red maple after cutting, this species is regarded as the most serious competitor of other species in the oak region *(46)*.

In the forest types of the Northeast in which red maple is a major component, it often is predominant in the advance understory reproduction. However, in some other sections of the country this is not usually true. Although red maple commonly is rated as mid-tolerant to tolerant *(2, 18)*, its tolerance apparently is variable: it tends to be more tolerant on good sites than on poor sites *(20)*, and more tolerant in some regions than others. A study in the Piedmont indicated that very young red maple seedlings re-

quire more light than those of yellow-poplar (an intolerant species), but less than those of loblolly pine *(28)*. In the lower Mississippi basin, red maple was found to do well only in openings; there it did not seem tolerant enough to grow under an overstory *(37)*.

When advance red maple reproduction is present in a stand, as is common in the Northeast, removal or death of the overstory by cutting or fire enables this established maple to dominate the succeeding stand at an early age and to continue to do so for many years. The domination of new stands by red maple seedlings or seedling sprouts from advance growth usually is strongly supplemented by sprouts originating from the stumps of older trees.

SAPLING STAGE TO MATURITY

Under ideal conditions, red maple trees may reach a height of 120 feet and a diameter of 5 feet *(22)*. Average mature trees, however, are 60 to 90 feet in height and 1½ to 2½ feet in diameter. It is a short-to medium-lived tree, seldom living longer than 150 years. In northern hardwood types, if natural successional processes are allowed free play, red maple begins to give way to sugar maple and other more tolerant hardwoods after about 80 years *(46)*.

Growth is rapid during early life, particularly during the pole stage, but later growth often is not well sustained. In managed, well-stocked, bottomland hardwood stands, an average diameter growth of 3 to 3½ inches in 10 years should be possible *(10)*. This rate of growth compares favorably with that of other bottomland hardwood species. In the northern part of its range, young trees grow faster than sugar maple, beech, or yellow birch, but slower than aspen, paper birch, or white ash.

Unlike most species, red maple sometimes grows faster on poorly drained than on well-drained soils. In Michigan, it was found that red maple of sprout origin grew almost twice as fast on wet organic soils as on mineral soils and drier organic soils.[3]

[3]Boughner, William S., and others. The lowland hardwood forest type in southern Michigan. Unpublished progress report. Lake States Forest Experiment Station. 34 pp., 1955.

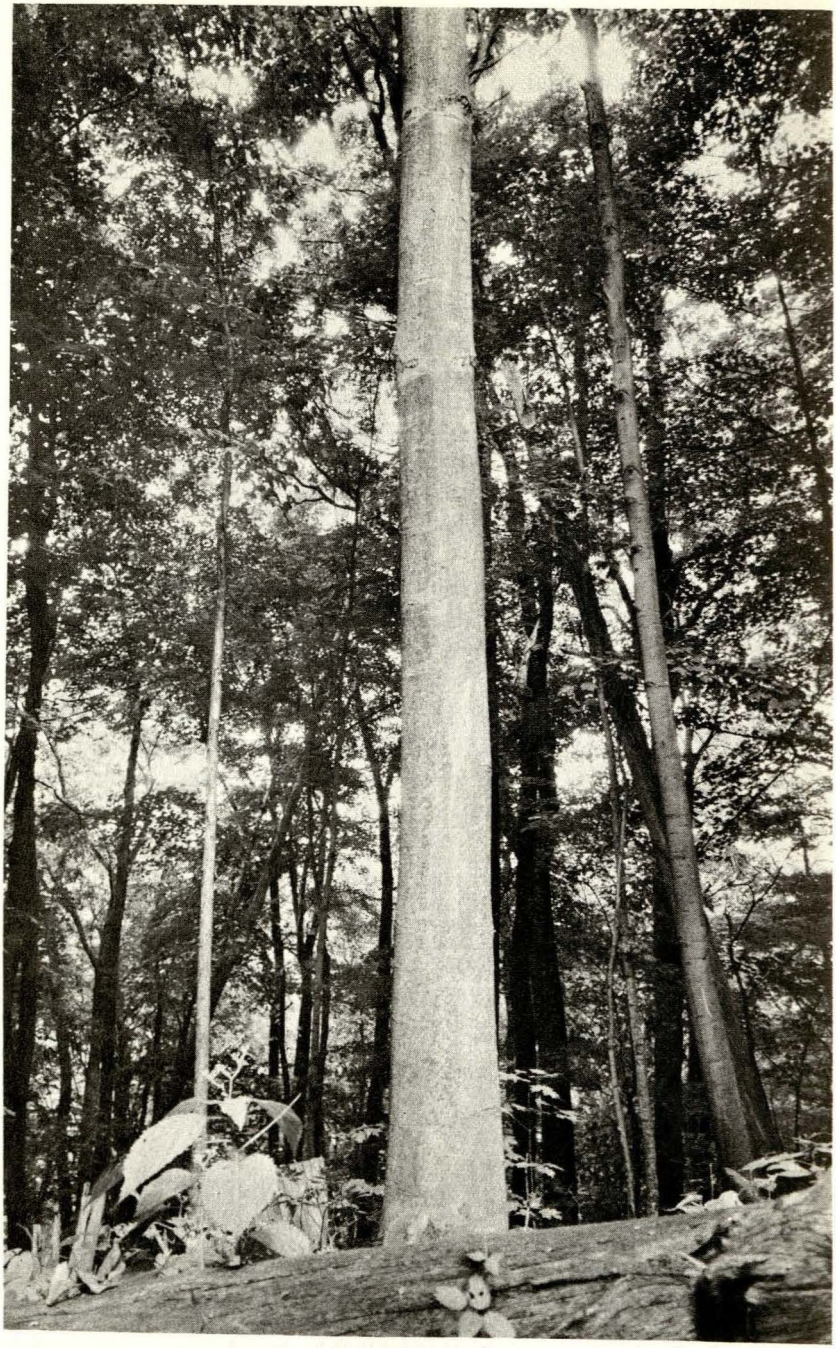

Figure 4.--*A red maple pole-size tree growing on a good site. When mature, this tree may produce high-quality sawlogs.*

The previously described response of red maple seedling roots to differences in environment, particularly in soil moisture, is maintained as the trees grow older. This characteristic no doubt contributes to the species' ability to grow on a wide range of sites, including sites too wet for most other members of the oak and northern hardwood forest types. On the Harvard Black Rock Forest in New York, Stout found that red maple roots at the stump varied more in depth than those of any of the eight other species that he studied *(40)*.

Red maple is considered to be a poor soil-builder. In comparison with various other tree species, red maple litter runs low in nitrogen; in calcium content it is classed as intermediate *(3)*.

A study of radial growth of 21 species of forest trees in the Georgia Piedmont showed that red maple started its growth late in the season *(26)*. Once growth began, it was very rapid. The radial growth for a season was half completed in 50 to 59 days and fully completed in 70 to 79 days.

Not much information is available on details of height growth. In a New York study of stem elongation, red maple saplings showed a different height-growth pattern for each of the 2 years of record *(15)*. Total height growth was from 1 to 2 feet--somewhat better than for the other species studied.

Red maple responds well to thinning. In a study in the Canadian Maritimes a 35-year-old fire stand of coppice red maple was thinned by reducing each sprout clump to one of the better stems *(41)*. The number of red maple stems per acre was reduced from 1,057 to 227 and the cubic foot volume from 1,071 to 408. Ten years later the 227 trees had more than doubled their volume--to 911 cubic feet per acre. In another study, a partial cutting was made on a 40-year old stand of Allegheny northern hardwoods. Of all the species, red maple made the best growth. In the 10-year period after cutting, dominant red maple trees grew on an average of 2.25 inches in diameter *(25)*.

Since red maple is usually found in mixed stands, no information is available about its potential yields. How-

ever, in the Appalachians, it is found in mixture on a wide variety of sites ranging in productive capacity from less than 2,000 to as much as 14,000 board-feet per acre in 50 years.

Defects and Enemies

On poor sites red maple is apt to have poor form and considerable defect. In northeastern Pennsylvania the average cull ranged from 13 percent in 12-inch red maple trees to 46 percent in 24-inch trees. Of the associated species, only beech and black birch were more defective *(16)*.

Defect is often a result of mechanical injury. Red maple is especially sensitive to wounding *(33)*. It heals slowly because of the dying back of a large area of cambium surrounding the wound. Wounds occurring during late winter and spring bleed more or less until the leaves develop. In shade-tree maintenance, this bleeding greatly reduces the efficacy of wound dressings. Callus growth, when established, is reasonably rapid; but an extra year or two is required to make up for the area lost by dieback.

Increment borings cause discoloration and decay in red maple as in various other hardwoods *(23)*. Because of cambial dieback and infection of the wounds, some increment borer holes in red maple may still be open after 10 years.

Red maple is highly susceptible to trunk rots; to this susceptibility the slow healing of wounds doubtless is a contributing factor. Most of the rot in red maple in the Northeast is caused by *Polyporus glomeratus (17)*. This fungus does not fruit on standing living trees--it produces only sterile conks, commonly associated with knots. More than one sterile conk indicates extensive rot, which usually is continuous between conks. Closed, swollen knots may conceal callused-over conks. Often 50 percent or more of the swollen knots of red maple have rot associations.

Next in importance among fungi causing rot in red maple is *Fomes connatus;* in some places this fungus may be more prevalent than *P. glomeratus (6).* A conk of *F. connatus* usually indicates rot in the trunk for about 3 feet both up and down. Other rot-causing fungi that attack red maple include *Daedalea unicolor* and *Hydnum septentrionale.*

A number of fungi cause cankers on red maple. In the Northeast, species of *Nectria* and *Eutypella* are the most common caused agents. Red maple may be cankered also by species of *Hypoxylon, Schizoxylon, Strumella,* and others.

Epicormic branching is not a serious problem with red maple. Compared to many of its associates, it has few epicormic branches in an uncut stand and shows little tendency to increase this type of branching after partial cutting *(27).*

Although red maple is host to many different insects, probably none of them will kill healthy trees. However, they do reduce vigor and growth, make the tree more susceptible to decay, and hasten the death of weakened trees. Susceptibility to insect attack is illustrated by a study made in the Piedmont hardwoods. Of forty species investigated, red maple had the highest percentage (79 percent) of insect attack *(9).* Among the more important borers attacking red maple are the gall-making maple borer *(Xylotrechus aceris),* the maple callus borer *(Conopia acerni),* and the Columbian timber beetle *(Corthylus columbianus) (12).* The common scale insects on red maple are the cottony maple scale *(Pulvinaria vitis),* the maple leaf scale *(P. acericola),* and the oystershell scale *(Lepidosaphes ulmi).* The common leaf-feeding moths are the gypsy moth *(Porthetria dispar),* the linden looper *(Erannis tilaria),* and the elm spanworm *(Ennomos subsignarius).* The forest tent caterpillar *(Malacosoma disstria),* on the other hand, avoids red maple *(4).*

Red maple is very susceptible to fire injury, and even large trees can be killed by moderate fires. The fire-killed trees sprout vigorously, however, and red maple may become a more important stand component after a fire than before.

Red maple ranks low in resistance to ice and snow

damage. More than a third of the red maple trees in a partially cut stand in northwestern Pennsylvania were damaged by a severe glaze storm in 1936 *(25)*. Red maple suffered more damage than any of the associated species except black cherry.

Being a preferred deer food, red maple is subject to much damage where these animals are abundant *(19)*. Reproduction may be almost completely suppressed in areas where there are excessive deer populations. Snowshoe hares also reduce the amount of red maple reproduction *(34)*.

Special Features

One of the outstanding features of red maple is its brilliant coloring in the fall. In the northern forests, its bright-red foliage makes a striking contrast with the dark green conifers and the white-barked, yellow-foliaged paper birches. Even in the spring it is very colorful with its bright red flowers.

The sap of red maple can be used in making maple syrup. However, the sugar content is only about half as much as that of sugar maple *(21)*.

Races and Hybrids

No direct evidence is known of the existence of races in this species. However, in view of its widespread occurrence, it seems likely that such races do exist.

Experimental crosses of red maple and silver maple have been made *(47)*. Since the flowering dates of these two species overlap slightly, natural hybrids are also possible *(48)*.

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*Balsam fir
*Red spruce
*Eastern hemlock
*Eastern white pine
*Pitch pine
*Virginia pine
*Atlantic white-cedar

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*Already published.

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